Abstract

This thesis addresses the problem of positional consensus of multiagent system. A positional consensus is achieved when the agents converge to a point. Some applications of this class of problem is in mid-air refueling of the aircraft or Unmanned Air Vehicles (UAVs), targeting a geographical location, etc. In this research work some positional consensus algorithm have been developed. They can be categorized in two part (i) Broadcast based algorithm (ii) Distributed based algorithm.

In case of broadcast based algorithm control strategies for a group of agents is developed to achieve positional consensus. The problem is constrained by the requirement that every agent must be given the same control input through a broadcast communication mechanism. Although the control command is computed using state information in a global framework, the control input is implemented by the agents in a local coordinate frame.

The mathematical formulation has been done in a linear programming framework that is computationally less intensive than earlier proposed methods. Moreover, a random perturbation input in the control command, that helps to achieve reasonable proximity among agents even for a large number of agents, which was not possible with the existing strategy in the literature, is introduced. This method is extended to achieve positional consensus at a prespecified location. A comparison between the Linear Programming (LP) approach and the existing Second Order Cone Programming (SOCP) based approach is also presented. Some of the algorithm has been demonstrated successfully on a robotic platform made from LEGO Mindstorms NXT Robots.

In the second case of broadcast based algorithm, a decentralized algorithm for a group of multiple autonomous agents to achieve positional consensus has been developed using the broadcast concept. Even here, the mathematical formulation has done using a linear programming framework. Each agent has some sensing radius and it is capable of sensing position and orientation with other agents within their sensing region. The method is computationally feasible and easy to implement.

In case of distributed algorithms, a computationally efficient distributed rendezvous algorithm for a group of autonomous agents has been developed. The algorithm uses a Rectilinear Decision Domain (RDD), as against the circular decision domain assumed in earlier work available in the literature. This helps in reducing its computational complexity considerably. An extensive mathematical analysis has been carried out to prove the convergence of the algorithm. The algorithm has also been demonstrated successfully on a robotic platform made from LEGO Mindstorms NXT Robots.